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MEASURING WEEKLY CHANGES IN THE MOVEMENT OF APPLES AND WINTER PEARS, 1955-56 MARKETING SEASON

(A PRELIMINARY REPORT)

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Marketing Research Division
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PREFACE

This is the second of two reports summarizing data on changes in the weekly movement of apples at retail in Philadelphia and at wholesale in Philadelphia, Atlanta, Chicago, and Los Angeles for the 1955-56 marketing season. The first report, "Weekly Changes in Movement of Apples--Selected Markets, 1955-56 Marketing Season Through Dec. 31, 1955," AMS-91, was released in February 1956.

The Deciduous Fruit and Tree Nut Research and Marketing Advisory Committee recommended that one phase of the Department's deciduous fruit research program be devoted to measurement of the movement of apples at the retail level and that an evaluation be made of different methods employed from a cost and efficiency standpoint. The project was conducted in the Agricultural Marketing Service by the Market Development Branch, Marketing Research Division, in close collaboration with the Office of Statistical Clearance and Standards, and with the aid of the Market News Branch, Fruit and Vegetable Division, in collecting wholesale data.

Appreciation is expressed for the cooperation of the many retail store managers and receivers in terminal markets in supplying data. Appreciation is expressed also to Harold Copple, secretary-manager, Washington State Apple Commission; R. A. Patterson, executive secretary, Oregon-Washington-California Pear Bureau; Carrol R. Miller, secretary-manager, Appalachian Apple Service, Inc.; W. J. Klotzbach, executive secretary, Western New York Apple Growers Association, Inc.; Truman Nold, National Apple Institute; and Fred Burrows, International Apple Association, for the part each played in making the results of this research work available to the members of their organizations in weekly newsletters and reports.

February 1957 Agriculture-Washington

MEASURING WEEKLY CHANGES IN THE MOVEMENT OF APPLES AND WINTER PEARS, 1955-56 MARKETING SEASON 1/

This is a preliminary and incomplete report. It is a reproduction for limited distribution of part of a larger report that is in manuscript form and will be issued later. It is issued now so that practical findings may be available to the industry as early as possible.

By Earl E. Houseman, statistician, and
William S. Hoofnagle and
L. Donald McMullin, agricultural economists

HIGHLIGHTS

The major purpose of this study was to learn whether reports of weekly changes in retail sales of apples and winter pears in major cities would provide a good guide for shippers in deciding when and where to send their products. If satisfactory estimates of week-to-week changes in retail sales could be obtained, it was hoped they would guide shippers in moving their products to markets where sales were heavy and supplies relatively light.

Sixty stores in Philadelphia were used as a sample to test the retail reporting plan; and two methods, observation and audit, were tried. Using the observation method, an enumerator recorded sales during 1 hour a week in each store; and through weekly audits of the stores, records of purchases and inventories of the fruits were obtained. The 60 stores were divided into two comparable groups of 30 stores, so that comparison could be made of the difference in the week-to-week changes in sales as shown in the two separate samples.

Neither of the two methods tested, using a sample of 30 or 60 stores, produced data on increases or decreases in volume of sales that were satisfactory as a guide for making week-to-week marketing decisions. Differences in data between the two groups of 30 stores were wide, and often showed opposite trends in sales for the same week. The retail sales data did provide a guide to longer term trends in sales, but information reflecting trends taking place over several weeks is available through wholesale disappearance and market unload reports of the U. S. Department of Agriculture. The retail data, therefore, provided little, if any, additional information to what is already available.

The retail reporting on week-to-week changes in sales is several times more expensive than measuring changes in movement at wholesale. In considering the retail methods, cost becomes of paramount importance, particularly so if the measurement of movement is to be taken in several cities.

1/ The retail store information is based on data collected by Audits and Surveys Company, Inc., under contract with the U. S. Department of Agriculture. The wholesale market information was collected by the Department through a joint undertaking of the Market News Service, Fruit and Vegetable Division, and the Market Development Branch, Marketing Research Division.

BACKGROUND

The apple and pear industries, along with producers and shippers of other perishable commodities, are confronted with the problem of estimating the flow into consumption, as distinguished from rate of movement from producing areas. Because apples are stored by wholesalers, jobbers, and other receivers in the market, shippers in the production areas are unable to estimate the effect of shipment of a given volume of this fruit into specific markets. As the distance increases between the points of production and consumption, the problem of estimating the effects of additional movements of apples and pears to market and changes in the level of stocks in the consumption area becomes much more acute. The need for estimates of current changes in effective demand for apples and winter pears, and of the quantities of these commodities held by receivers, wholesalers, and jobbers has long been recognized by the respective industries. The trade needs not only information on the total movement of apples, but also on the movement of apples by variety, since effective demand may vary greatly within the season between particular varieties.

There are substantial fluctuations in the movement to market of pears and apples within and between seasons. One of the major problems facing both industries, therefore, is that of developing a means of smoothing the flow of these products to consuming centers. Knowledge of changes in the rate of movement of these products through the marketing channels is needed to prevent excess supplies in some markets while there is a scarcity in other markets.

Wide fluctuations in prices of these commodities, which in turn may be directly related to oversupply or undersupply in the particular market, may have an adverse effect on returns to producers.

At the request of the apple and winter pear industries, work was undertaken to measure week-to-week changes in the movement of apples and winter pears. The industries were interested in having a measure of changes in sales of their products on a weekly basis in an Eastern city. The Department was interested in cooperating with the industries, not only to provide the trade with information on week-to-week changes in sales, but also because it wished to appraise the effectiveness of different methods of obtaining accurate data and the costs involved in different approaches employed in measuring the movement of a semiperishable product through marketing channels.

As a part of the work, data on changes in the weekly movement of apples at the wholesale level were obtained in four markets--Atlanta, Ga.; Chicago, Ill.; Los Angeles, Calif.; and Philadelphia, Pa. These markets were chosen because they were believed to be representative of different geographical regions and to reflect different market structures. Work at the wholesale level was undertaken to determine whether weekly wholesale disappearance data might reflect movement well enough to provide a guide for producers and shippers in making marketing decisions. Work at the wholesale level made possible comparisons in the movement at retail and wholesale in the Philadelphia market. Wholesale disappearance data included the movement of apples to both retail and institutional outlets, but gave no indication of the amounts moving into outlying areas normally serviced by brokers in each of the markets. Information could not readily be obtained on the quantity of apples moving from the metropolitan

market to the outlying areas. Measurement of movement at the wholesale level is not discussed in detail in this report; a complete analysis will be contained in the full report now in preparation.

During the 1955-56 marketing season, information on weekly changes in retail sales in Philadelphia (as well as wholesale disappearance and inventory of apples on hand in Atlanta, Chicago, Los Angeles, and Philadelphia) was released to the trade by teletype each Monday morning. It covered the movement during the prior week. This information was also made a part of the Market News reports for other interested markets.

PROCEDURE AND INFORMATION COLLECTED

A probability sample of 60 retail food stores was selected in Philadelphia, in which the movement of apples and winter pears was measured. To qualify for this study, a store had to be a self-service supermarket with two or more checkout counters, and to have a produce department. The universe of stores included outlets from national chains, voluntary cooperative groups, and independent stores.

To obtain the sample of stores, a preliminary survey was conducted, using a probability sample of 263 stores, based on a grocery store route list and an area sample prepared from Sanborn maps. This survey provided information on eligibility, and hence a list of eligible stores from which a random sample of 60 retail food stores was selected for the study. The 60-store sample was divided into 2 equivalent independent samples of 30 stores each, samples A and B. The purpose was to ascertain the changes occurring in the week-to-week movement in each of the two samples, which is one means of providing information about the magnitude of random variation due to sampling. Cooperation was obtained from all stores except two independent stores that were dropped early in the survey because of limited cooperation, and one large chain group. Substitutions were made for such stores.

There is a wide selection of apple varieties on the commercial market. The choice of a variety by the consumer is usually motivated by the intended use of the apples; that is, use for cooking, eating raw, or baking. To provide information regarding the movement by variety, the study was designed to show week-to-week changes in sales by major Western and Eastern varieties. The week-to-week movement data for winter pears were obtained by size and grade. The study covered the period October 1955 through April 1956 for apples, and from December 1955 through April 1956 for winter pears.

Two methods were used in measuring the week-to-week retail movement of apples and winter pears. They are called (1) the audit method, and (2) the observation method.

By the audit method, retail sales were determined each week on the basis principally of records of receipts and inventories in each of the 60 stores. Inventories of apples and winter pears were taken in individual stores at the same time each week during Monday, Tuesday, or Wednesday, when data were collected on receipts, spoilage, withdrawals, and transfers. Audit data covered

sales for one complete week, indicating total retail sales. For apples, the information was made available by principal varieties and for winter pears, by size and grade.

In recording sales of apples and winter pears by the observation method, enumerators were in sample stores for one hour each week during Thursday, Friday, or Saturday, to observe and record customer purchases of apples by variety and area of origin, and of winter pears by size and grade, and prices paid per pound for each commodity. In the preliminary survey, information was obtained on the hours that each store was open and volume of customer traffic by hours for use in classifying the hours as to light, medium, or heavy customer traffic. With this information it was possible to select the hours for observation so that proportionate representation from the 3 groups of hours was obtained, although only 1 observation period was selected for each store. The 1-hour periods of observation were divided into 2 consecutive 30-minute periods in order to evaluate the length of the observation period in terms of sampling error.

Observations of consumer purchases were confined to the last 3 days of the week because store traffic is normally heaviest during this period and because the field staff was used for the audits during the first part of the week. The time schedule for taking observations in the sample stores remained fixed from week to week, except that sample A was used for further experimental work, beginning with the second week of February. After February 4, the schedule for taking observations was changed from week to week in accordance with an experimental plan not discussed herein. Before the plan was put into effect, it was recognized that the observation data from the new methodology used on sample A would be of questionable value for making current estimates of changes. Accordingly, the observation data from sample A were not used after February 4 in making the current estimates and are not included in any tables or charts appearing in this report. Hence, in table 1, for example, the observation data shown for the weeks after February 4 are based only on sample B rather than on all 60 stores.

During an observation period, enumerators collected data on the proportion of apples being sold in packages and in bulk, and the number of stores displaying either packages, bulk, or both. Also, information was collected on the number of customers passing the apple and winter pear displays. The customer is defined as an individual or a family unit shopping jointly who passes the fruit display. Also recorded were the retail prices of closely competing fruits; any change in size, location, or type of display from week to week; and weather conditions during the store observation periods.

During an observation period, the enumerators also rated the apples and winter pears on display as of good, fair, or poor quality (condition). The rating given these commodities by the enumerators was based on selected characteristics which were predetermined. 2/

2/ Weekly Changes in Movement of Apples, Selected Markets, 1955-56 Marketing Season Through Dec. 31, 1955. U. S. Dept. Agr., Feb. 1956, AMS-91.

Price information for apples was obtained by variety and area of origin, and was collected by the observation method on Thursday, Friday, or Saturday. For winter pears, price information was collected by grade and size during the same three days. Prices were reported to the trade for these commodities as (1) most frequent, (2) highest, and (3) lowest. This provided the apple and winter pear industries with an indication of the weekly range in retail prices. Using the audit method, a weighted spot price per pound was obtained for apples on sale during Monday, Tuesday, or Wednesday, depending on the day the audit was taken in the sample store.

FINDINGS

Sampling Errors

Theoretically, the estimates from the audit method of week-to-week changes in the amount of apples and pears sold should have considerably lower sampling errors than corresponding estimates from the observation method. This follows from the fact that the audit method measures all apples and pears sold by the sample stores during a week, whereas the observation method measures sales during only 1 hour. Other than lower sampling error, the audit method has few if any important methodological advantages over the observation method. As applied in Philadelphia, however, it was less expensive than the observation method, particularly in small stores. Results from observations taken on Thursday, Friday, and Saturday can be summarized and made available the following Monday, whereas, in the audit method, data for a comparable period of time are somewhat delayed by the taking of physical inventories during weekend periods. Another limitation of the audit method is that it requires exceedingly close cooperation with store personnel and often imposes on their time. In contrast, the observation method can be utilized with little or no inconvenience to store management or personnel. From the standpoint of obtaining large-scale cooperation from retail outlets, the observation method is desirable.

At the time this project was planned, the reliability of data on week-to-week changes in sales obtained by the observation method and a sample of about 25 or 30 stores was seriously questioned, because large sampling errors, relative to the true changes from week to week, were anticipated. As quotations of sampling standard errors may have little real meaning to persons without training in statistical methods, the sample of 60 stores was divided into 2 equivalent samples of 30 stores each. Each sample of 30 stores was a sample that might have occurred had one selected a sample of only 30 stores initially; hence, the differences between the 2 samples, which are shown later, are attributable to sampling error. The results based upon all 60 stores will be examined first.

Conceptually, no 2 of the 4 indexes of sales of apples, presented in table 1 and shown graphically in figures 1, 2, 3, 4, and 5, measure the same thing, although the general objective is to reflect changes in sales of apples for weekly periods ending with Saturdays. Therefore, with respect to week-to-week changes, one would not expect any 2 of the 4 indexes to agree exactly, even if there were no sampling errors or biases. As a result, a comparison of these indexes does not provide much information on accuracy. The differences between the two indexes from the observation method is perhaps of more interest than any other comparison from the point of view of methods. One of these two indexes,

labeled "Total," is based upon the aggregate sales of apples during the observation periods, and the second is based on sales per 100 customers. Hence the difference between these two indexes is a result of weekly differences in number of customers.

Sales per 100 customers reflects only one component of the change in total sales, even though the customer count includes both buyers and nonbuyers of apples. As an example, note the week ending December 24 (table 2). As compared to the previous week, the customer count was 28 percent higher, sales per 100 customers were only 4 percent higher, and the aggregate sales (the two components combined) were 34 percent higher. Sales per 100 customers may fail to show properly longer run trends in total sales. Table 2 shows that the customer count was definitely on a lower level during approximately the first 10 weeks, the result being that the index, based on sales per 100 customers, continued at an appreciably lower level beginning about the first of December (figs. 4 and 5). This did not occur for pears because the base period for the index was after the level of the customer count had changed (figs. 18, 19, and 20).

Tables 3 and 4 correspond respectively to tables 1 and 2 and show compilations from each sample of 30 stores, designated samples A and B. These indexes are shown graphically (figs. 6, 7, and 8). From a visual inspection of these figures one may conclude that a sample of 30 stores is sufficient to provide useful information, as in each case both samples show the same trends, but there are other factors to be considered. Is the choice of methods and source of data to be based primarily on (1) an objective of providing information on general trends in sales, or (2) on an objective of measuring shortrun (week-to-week) changes in consumer purchases to provide information for making marketing decisions of an immediate nature? If the former is the case, data on wholesale disappearance also show general trends and such data can be obtained at a much lower cost. Assuming the latter objective, the graphic illustrations (figs. 6, 7, and 8) do not give a good picture of the sampling errors pertaining to week-to-week changes (table 8).

The indicated week-to-week changes in sales of all varieties of apples are shown for each sample of 30 stores for the audit method and for the observation method, using 1-hour and 1/2-hour observation periods and aggregate sales rather than sales per 100 customers (table 5). For the observation method, changes in sales per 100 customers were computed for each sample and found to have approximately the same sampling error as percent changes in aggregate sales. As percent changes in sales per 100 customers do not have an appreciably lower sampling error and they reflect only one component of the change in sales, sales per 100 customers is not recommended as a measure of change in sales. In other words, use of sales per 100 customers would need to be justified as a more useful concept. Incidentally, one needs to have a good understanding of the limitations of sales per 100 customers if he is to avoid misuses. For example, disregarding sampling error, the fact that sales per 100 customers, as shown by the observation method, may be greater in City A than in City B does not necessarily mean that the per capita consumption is larger in City A than in City B.

Theoretically and on the basis of general experience, it was expected that the discrepancies between the two samples would be the least, on the average, for the audit method and for all varieties of apples (table 5). To illustrate

Table 1.--Apples: Index numbers of movement by specified methods, Philadelphia, Pa., by weeks, 1955-56 marketing season.

(October 1955 Average = 100)

Period ending 1/	Retail sales measured by--			
	Observation, 1 hour		Audit, 1 week	Disappearance from wholesale
	Total	Per 100 customers		
1955:				
October 8	91.4	102.3	112.4	104.2
October 15	87.8	88.4	92.2	81.8
October 22	101.8	96.2	90.8	104.6
October 29	119.0	113.4	104.8	109.3
November 5	106.6	96.0	97.5	101.4
November 12	93.2	84.6	85.5	75.4
November 19	78.4	72.3	82.4	84.2
November 26	58.4	56.2	73.2	68.7
December 3	69.9	63.7	81.5	61.6
December 10	68.9	63.5	76.5	105.0
December 17	77.7	65.0	78.5	81.8
December 24	103.7	67.5	85.6	104.8
December 31	73.4	59.7	64.2	72.5
1956:				
January 7	71.9	60.2	74.8	33.9
January 14	76.8	64.5	78.8	95.0
January 21	81.4	72.3	82.7	80.8
January 28	86.6	67.0	80.1	91.7
February 4	73.8	70.5	72.0	97.8
February 11	2/ 90.0	2/ 68.8	82.7	90.7
February 18	84.7	70.5	80.9	93.5
February 25	92.2	76.1	76.1	76.8
March 3	89.9	77.3	78.2	94.1
March 10	92.0	77.8	75.9	86.1
March 17	85.8	77.9	71.2	78.0
March 24	84.4	62.0	75.5	76.0
March 31	80.1	56.7	60.6	94.9
April 7	68.2	53.7	60.6	68.7
April 14	72.1	55.2	59.2	68.1
April 21	69.2	49.4	57.4	72.1
April 28	59.8	41.6		62.4

1/ These data are intended to reflect sales during a week ending Saturday.
2/ From this week on the data are based on only 30 stores.

Table 2.--Apples: Weekly retail sales and disappearance from wholesale level, Philadelphia, Pa., 1955-56 marketing season. 1/

Period ending 2/	Retail sales measured by--				Disappearance from wholesale
	Observation, 1 hour			Audit, 1 week	
	Quantity	Customers passing display	Sales per 100 customers		
	Pounds	Number	Pounds	1,000 pounds	1,000 bushels
1955:					
September 24	-	-	-	-	57.4
October 1	-	-	-	-	54.4
October 8	1,569	3,856	40.6	137.3	52.6
October 15	1,508	4,303	35.1	112.7	41.3
October 22	1,748	4,582	38.2	110.9	52.8
October 29	2,044	4,546	45.0	128.1	55.2
November 5	1,830	4,805	38.1	119.1	51.2
November 12	1,600	4,755	33.6	104.5	38.1
November 19	1,347	4,691	28.7	100.7	42.5
November 26	1,003	4,497	22.3	89.5	34.7
December 3	1,201	4,756	25.3	99.6	31.1
December 10	1,184	4,698	25.2	93.5	53.0
December 17	1,334	5,177	25.8	95.9	41.3
December 24	1,781	6,649	26.8	104.6	52.9
December 31	1,260	5,316	23.7	78.4	36.6
1956:					
January 7	1,234	5,159	23.9	91.4	17.0
January 14	1,318	5,155	25.6	96.3	48.0
January 21	1,397	4,873	28.7	101.0	40.8
January 28	1,487	5,593	26.6	97.9	46.3
February 4	1,268	4,525	28.0	88.0	49.4
February 11	1,546	5,654	27.3	101.1	45.8
February 18	1,455	5,208	28.0	98.8	47.2
February 25	1,583	5,247	30.2	93.0	38.8
March 3	1,543	5,031	30.7	95.5	47.5
March 10	1,579	5,115	30.9	92.7	43.5
March 17	1,474	4,688	31.4	87.0	39.4
March 24	1,449	5,901	24.6	92.3	38.4
March 31	1,375	6,124	22.5	74.1	47.9
April 7	1,171	5,497	21.3	74.1	34.7
April 14	1,238	5,662	21.9	72.3	34.4
April 21	1,189	6,067	19.6	70.1	36.4
April 28	1,027	6,241	16.5		31.5

1/ Observations and audits were made in 60 self-service food stores, each with 2 or more checkout counters, October 8, 1955, through February 4, 1956; but during balance of season the observation data from a sample of 30 self-service food stores were projected to represent data for 60 stores.

2/ These data are intended to reflect sales during a week ending Saturday.

Table 3.--Apples: Index numbers of retail sales in 2 subsamples of 30 stores each and disappearance from wholesale in Philadelphia, Pa., by weeks, 1955-56 marketing season. 1/

(October 1955 Average = 100)

Period ending 2/	Sales in subsample A as measured by--			Sales in subsample B as measured by--			Disappearance from wholesale
	Observation, 1 hour		Audit, 1 week	Observation, 1 hour		Audit, 1 week	
	Total	Per 100 customers		Total	Per 100 customers		
1955:							
October 8	91.4	93.3	117.7	91.3	110.8	106.3	104.2
October 15	83.4	86.6	94.2	92.1	89.5	90.1	81.8
October 22	101.1	100.2	84.6	102.5	92.4	97.3	104.6
October 29	124.1	119.8	103.1	114.1	106.8	106.5	109.3
November 5	108.3	102.6	102.4	104.9	90.0	92.0	101.4
November 12	96.8	94.3	77.9	89.7	76.6	93.7	75.4
November 19	88.0	78.8	91.1	69.3	65.3	72.6	84.2
November 26	66.8	60.6	66.8	50.3	50.8	80.2	68.7
December 3	70.4	66.6	84.5	69.5	60.8	78.1	61.6
December 10	71.5	72.8	69.9	66.5	56.3	83.6	105.0
December 17	73.0	64.0	73.2	83.1	65.8	84.3	81.8
December 24	113.4	70.6	82.0	94.4	63.4	89.2	104.8
December 31	69.4	58.9	55.5	77.2	60.3	73.5	72.5
1956:							
January 7	73.1	62.3	68.7	70.7	58.2	81.5	33.9
January 14	72.2	64.7	72.6	81.2	64.2	85.5	95.0
January 21	92.3	85.0	74.6	70.9	60.5	91.3	80.8
January 28	86.2	68.7	70.1	87.0	65.3	90.9	91.7
February 4	76.0	71.4	70.4	71.8	69.5	73.8	97.8
February 11			76.0	92.0	68.2	89.9	90.7
February 18			77.3	86.3	69.7	84.6	93.5
February 25			68.5	90.5	72.6	84.3	76.8
March 3			76.8	93.5	78.4	79.5	94.1
March 10			71.5	87.7	72.1	80.7	86.1
March 17			58.8	85.6	76.8	84.6	78.0
March 24			66.1	94.0	67.1	85.6	76.0
March 31			55.2	85.1	58.7	66.3	94.9
April 7			55.8	70.1	53.7	65.8	68.7
April 14			53.6	73.4	54.7	65.1	68.1
April 21			53.6	71.4	49.7	61.4	72.1
April 28				60.1	40.5		62.4

1/ Observation data from subsample A are not shown from February 4 on because, by design for experimental purposes not discussed herein, the schedule for taking observations changed from week to week.

2/ These data are intended to reflect sales during weeks ending with Saturdays.

Table 4.--Apples: Retail sales in 2 subsamples of 30 stores each and disappearance from wholesale in Philadelphia, Pa., by weeks, 1955-56 marketing season. 1/

Period ending 2/	Sales in subsample A as measured by--			Sales in subsample B as measured by--			Disappearance from wholesale
	Observation, 1 hour		Audit, 1 week	Observation, 1 hour		Audit, 1 week	
	Total	Per 100 customers		Total	Per 100 customers		
	Pounds	Pounds	1,000 pounds	Pounds	Pounds	1,000 pounds	1,000 bushels
1955:							
October 8	769	39.1	75.1	800	42.1	62.2	52.6
October 15	701	36.3	60.1	807	34.0	52.7	41.3
October 22	850	42.0	54.0	898	35.1	56.9	52.8
October 29	1,044	50.2	65.8	1,000	40.6	62.3	55.2
November 5	911	43.0	65.3	919	34.2	53.8	51.2
November 12	814	39.5	49.7	786	29.1	54.8	38.1
November 19	740	33.0	58.1	607	24.8	42.5	42.5
November 26	562	25.4	42.6	441	19.3	46.9	34.7
December 3	592	27.9	53.9	609	23.1	45.7	31.1
December 10	601	30.5	44.6	583	21.4	48.9	53.0
December 17	614	26.8	46.7	728	25.0	49.3	41.3
December 24	954	29.6	52.3	827	24.1	52.2	52.9
December 31	584	24.7	35.4	676	22.9	43.0	36.6
1956:							
January 7	615	26.1	43.8	619	22.1	47.7	17.1
January 14	607	27.1	46.3	711	24.4	50.0	48.0
January 21	776	35.6	47.6	621	23.0	53.4	40.8
January 28	725	28.8	44.7	762	24.8	53.2	46.3
February 4	639	29.9	44.9	629	26.4	43.2	49.4
February 11			48.5	806	25.9	52.6	45.8
February 18			49.3	756	26.5	49.5	47.2
February 25			43.7	793	27.6	49.3	38.8
March 3			49.0	819	29.8	46.5	47.5
March 10			45.6	768	27.4	47.2	43.5
March 17			37.5	750	29.2	49.5	39.4
March 24			42.2	824	25.5	50.1	38.4
March 31			35.2	746	22.3	38.8	47.9
April 7			35.6	614	20.4	38.5	34.7
April 14			34.2	643	20.8	38.1	34.4
April 21			34.2	626	18.9	35.9	36.4
April 28				527	15.4		31.5

1/ Retail observation and audit made in 2 subsamples (A and B) of 30 selected self-service food stores each, through February 4, 1956, when observations in subsample A were discontinued by change in experimental design.

2/ These data are intended to reflect sales during weeks ending with Saturdays.

Table 5.--Apples: Change in weekly retail sales, all varieties, in 2 subsamples of 30 stores each, expressed as a percentage of the previous week, Philadelphia, Pa., 1955-56 marketing season. 1/

Weeks 2/	All varieties					
	Audit		Observation			
			1 hour		1st half hour	
	A	B	A	B	A	B
	Percent	Percent	Percent	Percent	Percent	Percent
2	-20.0	-15.3	- 8.8	0.9	-10.4	-17.5
3	-10.1	8.0	21.3	11.3	24.9	26.7
4	21.9	9.5	22.8	11.4	24.9	9.5
5	- 0.8	-13.6	-12.7	- 8.1	-25.5	-15.5
6	-23.9	1.9	-10.6	-14.5	17.5	- 7.4
7	16.9	-22.4	- 9.1	-22.8	-17.8	-26.1
8	-26.7	10.4	-24.1	-27.3	-29.2	-34.7
9	26.5	- 2.6	5.3	38.1	19.6	50.5
10	-17.3	7.0	1.5	- 4.3	- 2.7	1.7
11	4.7	0.8	2.2	24.9	-16.8	18.4
12	12.0	5.9	55.4	13.6	79.4	6.3
13	-32.3	-17.6	-38.8	-18.3	-44.1	-11.6
14	23.7	10.9	5.3	- 8.4	21.2	-20.2
15	5.7	4.8	- 1.3	14.9	- 5.1	33.0
16	2.8	6.8	27.8	-12.7	36.3	- 7.5
17	- 6.1	- 0.4	- 6.6	22.7	- 8.9	21.2
18	0.4	-18.8	-11.9	-17.5	-13.6	-21.9

1/ Formula for computing the numbers in this table is $100 \left(1 - \frac{\text{sales preceding week}}{\text{sales current week}}\right)$.

2/ Changes shown in this table are from the preceding week to the week in this column.

the meaning of the numbers in this table, take week 10 as an example. For the audit method, sample A shows a 17.3 percent decrease in sales and sample B shows a 7.0 percent increase as compared to the previous week. This is chance variation, depending upon which sample one may happen to have selected. The changes in weekly sales for all apples recorded by the methods of audit, observation 1 hour, and observation 1/2 hour are shown graphically (figs. 9, 10, and 11). Even for the audit method and all apples, the two samples agree with respect to direction of the change between successive weeks in only 10 cases out of 17. On the basis of chance, agreement as to direction of change would be expected in 50 percent of the cases on the average under the hypothetical condition that the true amounts purchased remain unchanged from week to week. In only 6 cases out of 17 is the difference between the percent changes by the two samples less than 10 percent and in 4 cases the differences are greater than 25 percent. For the observation method, the discrepancies are greater.

The sampling errors for varieties by State of origin average considerably larger than the sampling errors for sales of all varieties. The results for Eastern and Western Delicious apples are shown in tables 6 and 7 and charted in figures 12 through 17.

Information on sampling error that is of greater utility, technically, than comparisons between the 2 samples of 30 stores is provided by the estimated standard errors (table 8). These errors apply to ratios of sales in one week to sales in the preceding week, and are for a sample of 30 stores. Corresponding standard errors for a sample of 60 stores can easily be computed by multiplying each number in the table by 0.7. In other words, increasing the size of the sample from 30 to 60 reduces the sampling error by 30 percent.

Table 6.--Apples: Change in weekly retail sales, Eastern Delicious variety, in 2 subsamples of 30 stores each, expressed as a percentage of the previous week, Philadelphia, Pa., 1955-56 marketing season. 1/

Weeks, October thru week ending Feb. 4. 2/	Eastern delicious					
	Audit		Observation			
			1 hour		1st half hour	
	A	B	A	B	A	B
	Percent	Percent	Percent	Percent	Percent	Percent
2	-35.0	-20.7	-36.7	-45.1	-38.0	-63.6
3	-27.3	- 2.6	86.3	45.6	117.5	91.6
4	4.2	-26.8	-56.0	- 6.0	-56.9	-10.4
5	-29.4	-11.5	-32.5	- 9.8	-39.3	- 9.8
6	-18.0	13.8	36.4	-50.5	52.3	-55.1
7	3.5	-50.7	- 2.3	-63.7	-14.1	-65.2
8	-22.0	18.8	- 9.9	-24.5	-16.5	- 4.3
9	14.1	15.9	-22.6	172.5	-19.7	177.3
10	-21.0	-26.3	-18.3	0.9	-17.5	-32.8
11	74.7	25.7	73.5	96.4	76.6	168.3
12	- 4.1	6.8	63.5	-22.7	77.1	-38.2
13	-34.5	-28.7	-57.2	-31.1	-67.3	0
14	12.1	1.5	36.1	-14.8	68.8	-29.4
15	35.3	47.1	-13.0	96.9	-27.2	118.8
16	- 5.1	- 6.0	18.4	-27.5	59.3	-27.6
17	-38.9	- 4.3	-12.6	-30.0	-14.9	-31.6
18	12.5	-33.3	-29.5	-21.4	-15.0	-30.8

1/ Formula for computing the numbers in this table is $100 \left(1 - \frac{\text{sales preceding week}}{\text{sales current week}}\right)$.

2/ Changes shown in this table are from the preceding week to the week in this column.

Table 7.--Apples: Change in weekly retail sales, Western Delicious variety, in 2 subsamples of 30 stores each, expressed as a percentage of the previous week, Philadelphia, Pa., 1955-56 marketing season. 1/

Weeks, October thru week ending Feb. 4. 2/	Western delicious					
	Audit		Observation			
			1 hour		1st half hour	
	A	B	A	B	A	B
	Percent	Percent	Percent	Percent	Percent	Percent
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	8.0	8.3	51.2	100.0	54.5	44.4
5	22.2	-23.1	-16.1	91.7	-29.4	23.1
6	18.2	50.0	-19.2	32.6	25.0	106.2
7	74.4	46.7	83.3	- 4.9	60.0	-36.4
8	- 7.4	6.1	-11.7	13.8	-10.4	4.8
9	11.1	-15.7	- 5.9	- 3.0	-16.3	63.6
10	-14.3	47.5	50.0	26.6	38.9	33.3
11	- 6.7	4.6	-10.4	49.4	-48.0	12.5
12	55.4	16.5	83.7	38.0	238.5	51.9
13	-28.7	- 3.8	-34.8	-30.5	-37.5	-31.7
14	17.7	- 4.9	-31.1	-12.1	-25.5	-35.7
15	-15.1	13.4	25.4	28.4	22.0	66.7
16	14.5	- 3.6	- 4.5	-20.6	6.0	-16.7
17	39.4	- 0.9	45.9	38.5	15.1	36.0
18	-15.2	-20.6	-21.0	5.6	-27.9	14.7

1/ Formula for computing the numbers in this table is $100 \left(1 - \frac{\text{sales preceding week}}{\text{sales current week}}\right)$.

2/ Changes shown in this table are from the preceding week to the week in this column.

Table 8.--Standard errors of week-to-week ratios for a sample of 30 stores, Philadelphia, Pa., 1955-56 marketing season.

Commodity	Standard error		
	Observation		Audit
	1 hour	1/2 hour	
All apples	.12	.15	.09
All Eastern apples	.13	-	.09
Eastern Delicious	.22	-	.11
Eastern McIntosh	.32	-	.17
Eastern Stayman	.33	-	.15
All Western apples	.24	-	.20
Western Delicious	.31	-	.23
Pears	.21	.25	.11

To illustrate the interpretation of the estimated standard errors, consider sales data on Eastern Delicious apples collected by the observation method with a one-hour observation period. The standard error of the ratio of sales for a given week to the preceding week is estimated to be 0.22, assuming that the sample of stores and the time schedule of observation periods remain unchanged from week to week. A standard error as large as 0.22 is disconcerting. For example, a true increase of 10 percent in sales could take place, but it would not be unusual for a sample estimate of this change to be outside the range .90 to 1.30. The odds are roughly 1 in 6 that the estimate would be less than .90, that is, show a decrease of more than 10 percent, when in fact an increase of 10 percent had taken place. Likewise, the odds are roughly 1 in 6 that a sample estimate would be larger than 1.30; that is, indicate an increase of more than 30 percent. Sampling errors for the audit method are appreciably lower. The practical implications of this will be commented on briefly later herein.

Although a sample of 30 stores may be adequate to detect or reflect pronounced trends taking place over a month or two, the precision with which changes are measured from one week to another is very poor. As indicated above, the sampling standard errors for a sample of 60 stores is about 30 percent less than for a sample of 30 stores. The sampling errors for 60 stores are still large (especially for the observation method) relative to the magnitude of the quantities to be measured. In fact, the sampling errors pertaining to weekly differences are so large that serious doubt is cast on the value of the results except for showing long-run trends.

In large stores, taking an audit is somewhat more expensive than in small stores. Generally, the audit method is less expensive than the observation method, particularly in the smaller stores. However, in large stores it may be

more difficult to obtain an accurate audit; and from the standpoint of sampling error, a detailed analysis indicated that the relative advantage of the audit over the observation method is less for large stores than small ones, which suggested the possibility of using a combination of the two, as is being tried during the 1956-57 year. 3/

Further Study Under Way

In the 1956-57 study of the measurement of movement of apples in the Philadelphia metropolitan market, a sample of 100 stores is being used. This sample was allocated by size groups of stores in what was judged to be an "optimum" manner. The observation method is being used in 41 sample stores selected from the strata composed of large stores. In 59 stores the audit method is being used. The observation periods in the 41 stores are distributed over a week in what was estimated from the previous year's data to be an optimum arrangement. Without getting into detail, this means that for each store the hours of the week were divided into groups--slow, medium, and busy on the basis of rate of sales--and the schedule of observations is such that the sampling rate is least and the length of observation period is the longest for the slow group. In each of the 41 stores there is only 1 observation period per week, and the time schedule for observations remains fixed from week to week. Distribution of the sample over the week means that it reflects (overlooking the problem of sampling error) sales during a week rather than just part of a week. As data from a probability sample can be projected to population totals, this is being done during the current year. Information on changes is of limited utility unless it can be interpreted in terms of volume. It was believed that, even if the projected totals were not on the right level, the results would be more useful than simply showing rates of change. The ratio of sales for one week to the preceding week is the same for expanded and unexpanded sample data, so the situation regarding the sample error of ratios showing change is not affected by the expansion of the sample data.

3/ It is expected that these and other details may be discussed in a more technical publication to appear later.

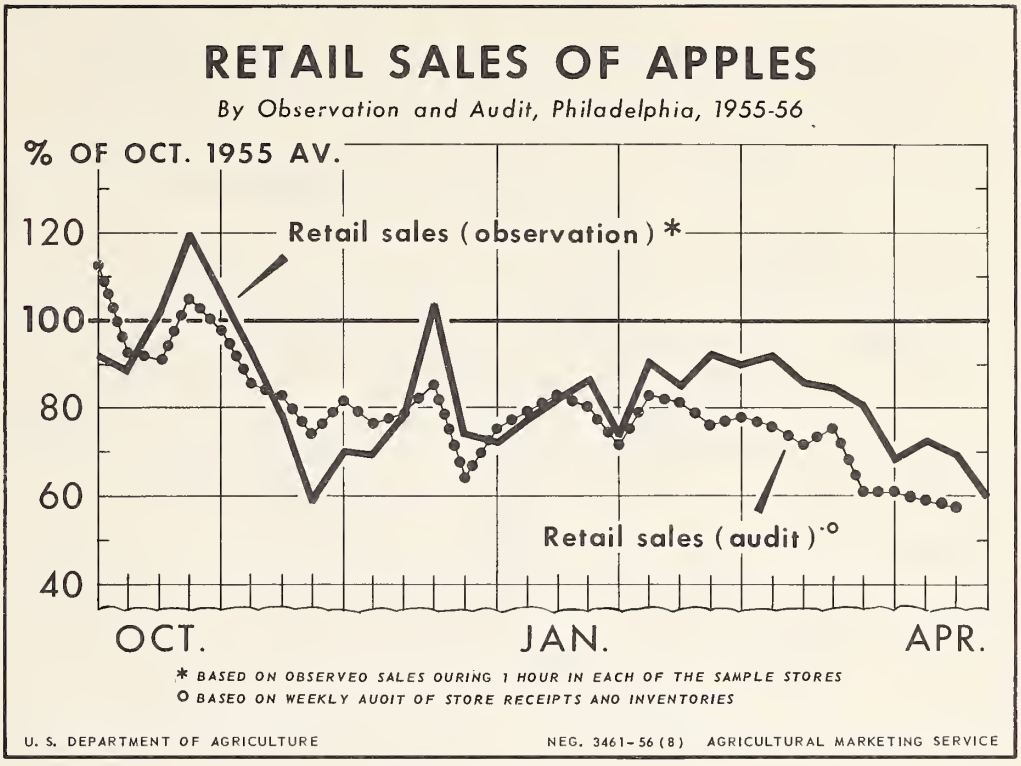

Figure 1.

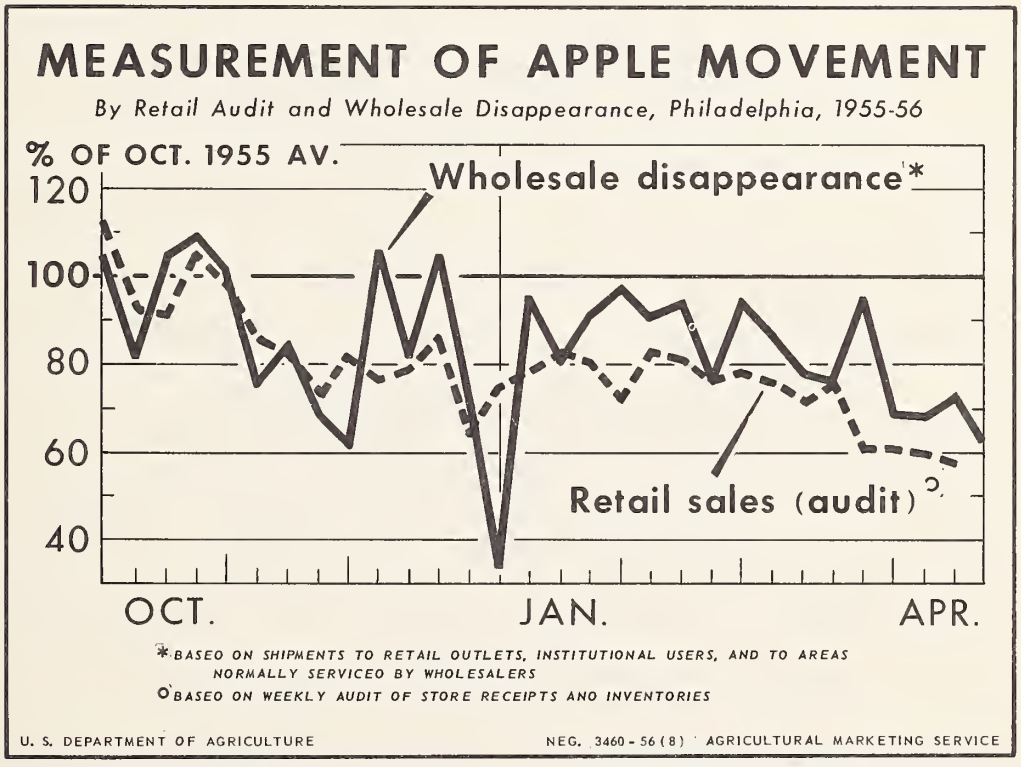
MEASUREMENT OF APPLE MOVEMENT
By Retail Audit and Wholesale Disappearance, Philadelphia, 1955-56
% OF OCT. 1955 AV.
120
100
80
60
40
Wholesale disappearance *
Retail sales (audit) °
OCT.
JAN.
APR.
* BASED ON SHIPMENTS TO RETAIL OUTLETS, INSTITUTIONAL USERS, AND TO AREAS NORMALLY SERVICED BY WHOLESALERS
° BASED ON WEEKLY AUDIT OF STORE RECEIPTS AND INVENTORIES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 3460-56 (8) AGRICULTURAL MARKETING SERVICE

Figure 2.

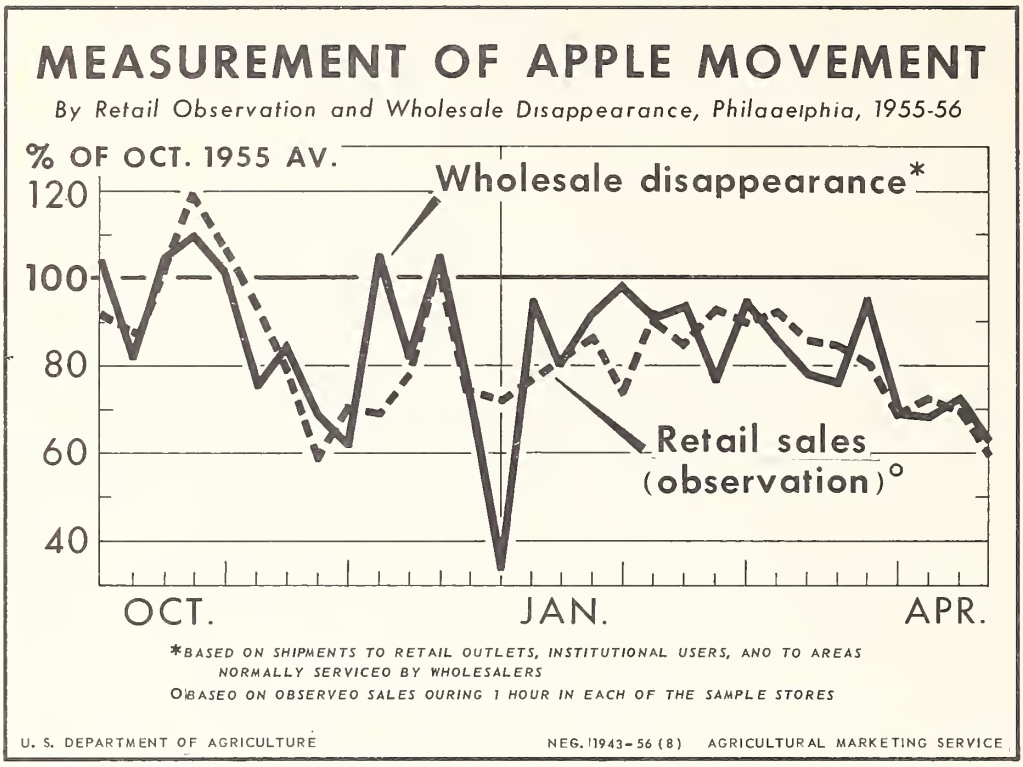
MEASUREMENT OF APPLE MOVEMENT
By Retail Observation and Wholesale Disappearance, Philadelphia, 1955-56
% OF OCT. 1955 AV.
120
100
80
60
40
Wholesale disappearance*
Retail sales (observation)°
OCT.
JAN.
APR.
*BASED ON SHIPMENTS TO RETAIL OUTLETS, INSTITUTIONAL USERS, AND TO AREAS NORMALLY SERVICED BY WHOLESALERS
°BASED ON OBSERVED SALES DURING 1 HOUR IN EACH OF THE SAMPLE STORES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 11943-56 (8) AGRICULTURAL MARKETING SERVICE

Figure 3.

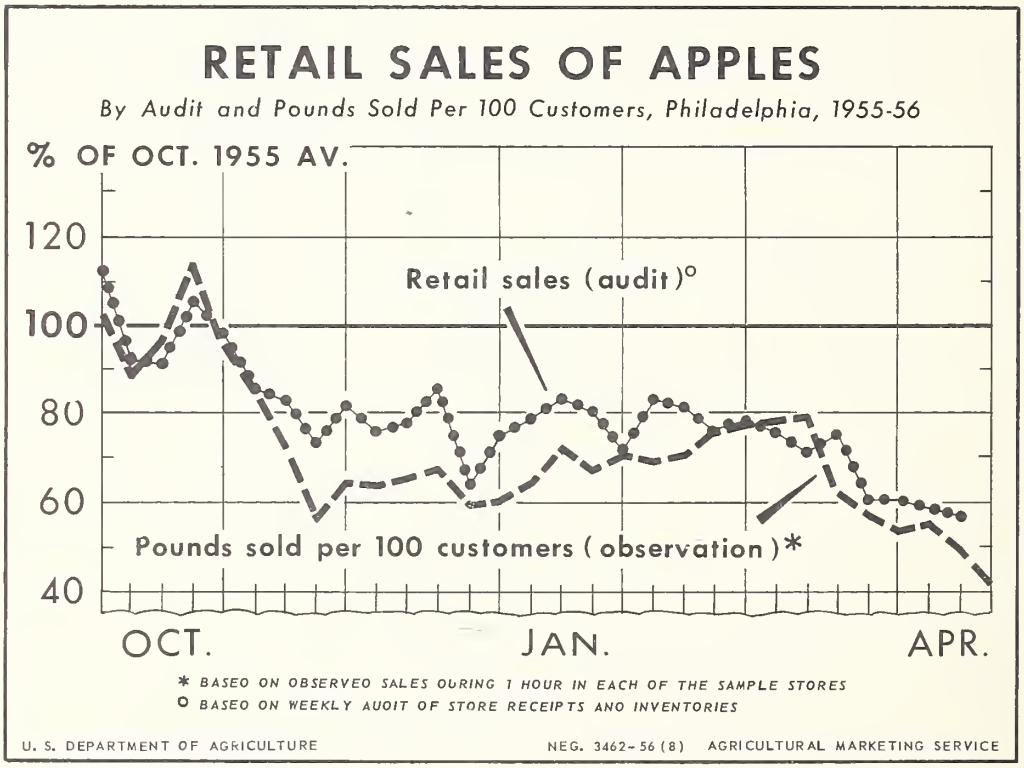
RETAIL SALES OF APPLES
By Audit and Pounds Sold Per 100 Customers, Philadelphia, 1955-56
% OF OCT. 1955 AV.
120
100
80
60
40
Retail sales (audit)°
Pounds sold per 100 customers (observation)*
OCT.
JAN.
APR.
* BASED ON OBSERVED SALES DURING 1 HOUR IN EACH OF THE SAMPLE STORES
° BASED ON WEEKLY AUDIT OF STORE RECEIPTS AND INVENTORIES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 3462-56 (8) AGRICULTURAL MARKETING SERVICE

Figure 4.

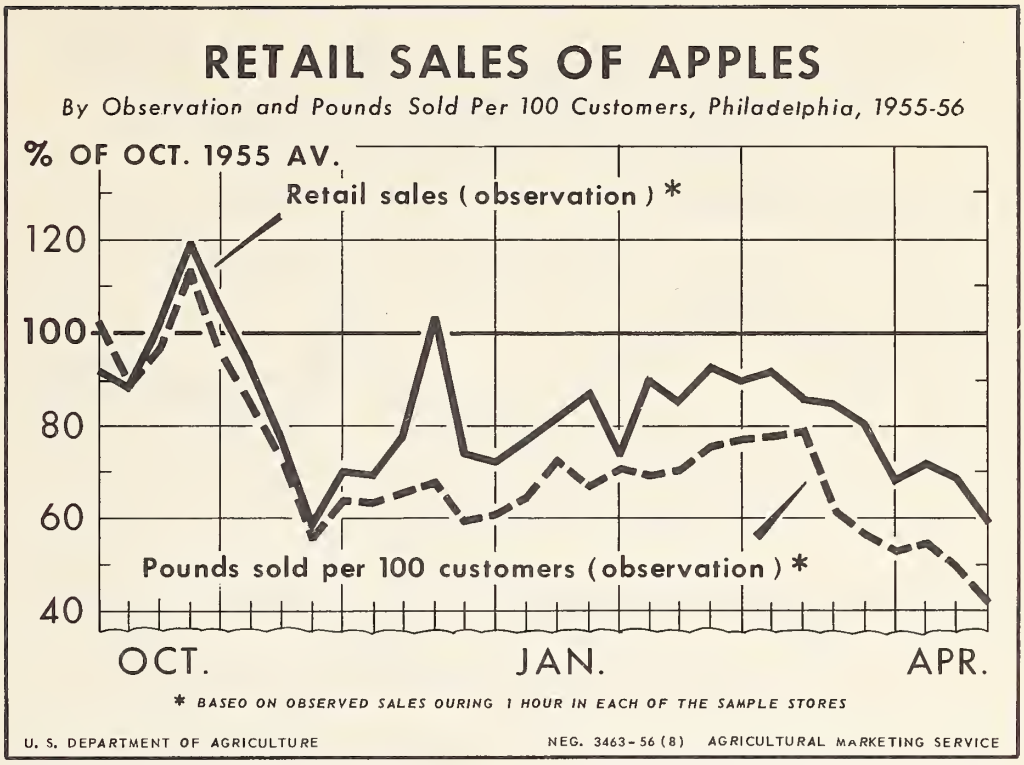
RETAIL SALES OF APPLES
By Observation and Pounds Sold Per 100 Customers, Philadelphia, 1955-56
% OF OCT. 1955 AV.
Retail sales (observation) *
120
100
80
60
Pounds sold per 100 customers (observation) *
40
OCT.
JAN.
APR.
* BASED ON OBSERVED SALES DURING 1 HOUR IN EACH OF THE SAMPLE STORES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 3463-56 (8) AGRICULTURAL MARKETING SERVICE

Figure 5.

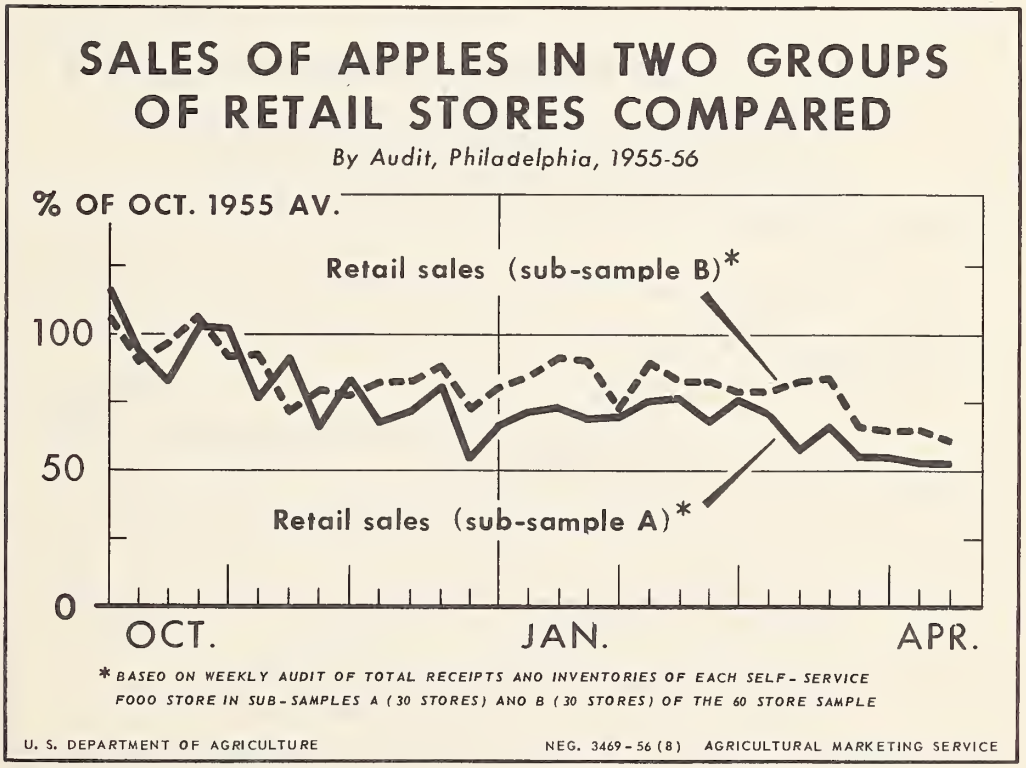
SALES OF APPLES IN TWO GROUPS OF RETAIL STORES COMPARED
By Audit, Philadelphia, 1955-56
% OF OCT. 1955 AV.
Retail sales (sub-sample B)*
100
50
Retail sales (sub-sample A)*
0
OCT.
JAN.
APR.
* BASED ON WEEKLY AUDIT OF TOTAL RECEIPTS AND INVENTORIES OF EACH SELF-SERVICE FOOD STORE IN SUB-SAMPLES A (30 STORES) AND B (30 STORES) OF THE 60 STORE SAMPLE
U. S. DEPARTMENT OF AGRICULTURE
NEG. 3469-56 (8) AGRICULTURAL MARKETING SERVICE

Figure 6.

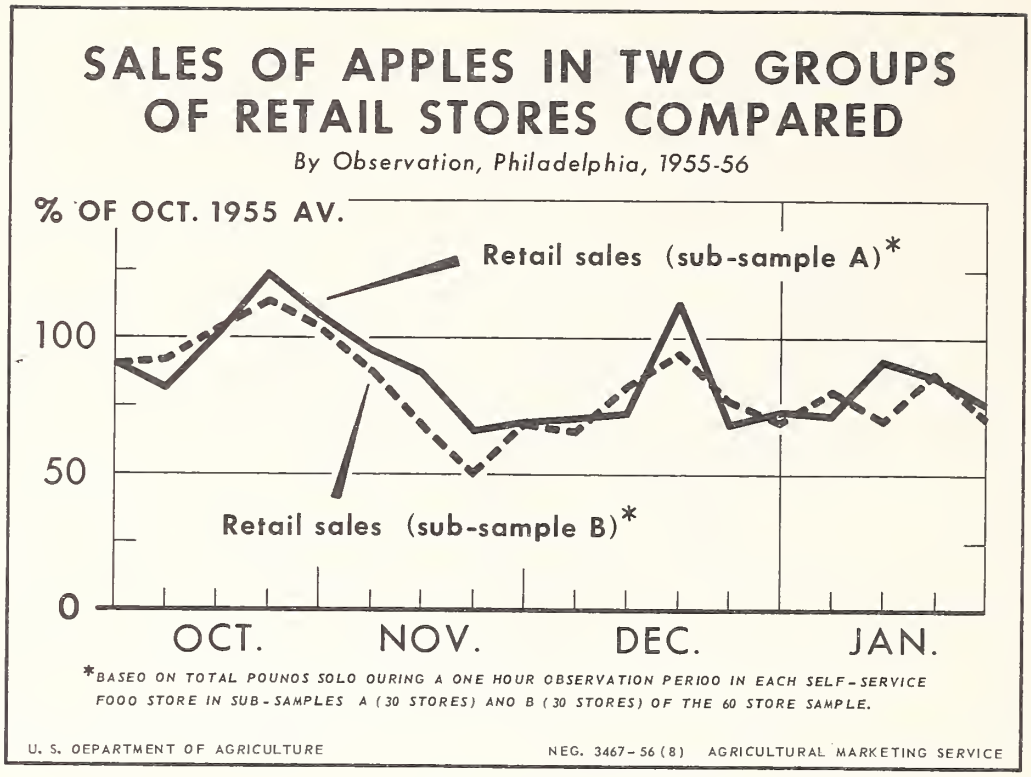
SALES OF APPLES IN TWO GROUPS OF RETAIL STORES COMPARED
By Observation, Philadelphia, 1955-56
% OF OCT. 1955 AV.
Retail sales (sub-sample A)*
100
50
Retail sales (sub-sample B)*
0
OCT.
NOV.
DEC.
JAN.
*BASED ON TOTAL POUNDS SOLD DURING A ONE HOUR OBSERVATION PERIOD IN EACH SELF-SERVICE FOOD STORE IN SUB-SAMPLES A (30 STORES) AND B (30 STORES) OF THE 60 STORE SAMPLE.
U. S. DEPARTMENT OF AGRICULTURE
NEG. 3467-56 (8) AGRICULTURAL MARKETING SERVICE

Figure 7.

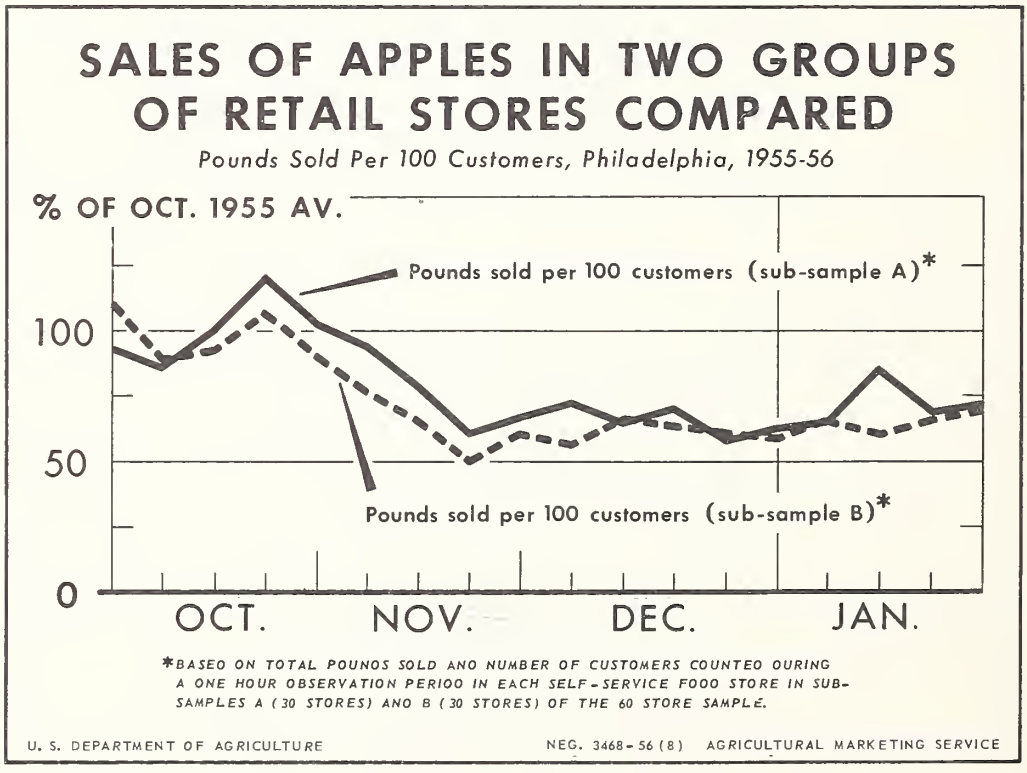
SALES OF APPLES IN TWO GROUPS OF RETAIL STORES COMPARED
Pounds Sold Per 100 Customers, Philadelphia, 1955-56
% OF OCT. 1955 AV.
Pounds sold per 100 customers (sub-sample A)*
100
50
Pounds sold per 100 customers (sub-sample B)*
0
OCT.
NOV.
DEC.
JAN.
*BASED ON TOTAL POUNDS SOLD AND NUMBER OF CUSTOMERS COUNTED DURING A ONE HOUR OBSERVATION PERIOD IN EACH SELF-SERVICE FOOD STORE IN SUB-SAMPLES A (30 STORES) AND B (30 STORES) OF THE 60 STORE SAMPLE.
U. S. DEPARTMENT OF AGRICULTURE
NEG. 3468-56 (8) AGRICULTURAL MARKETING SERVICE

Figure 8.

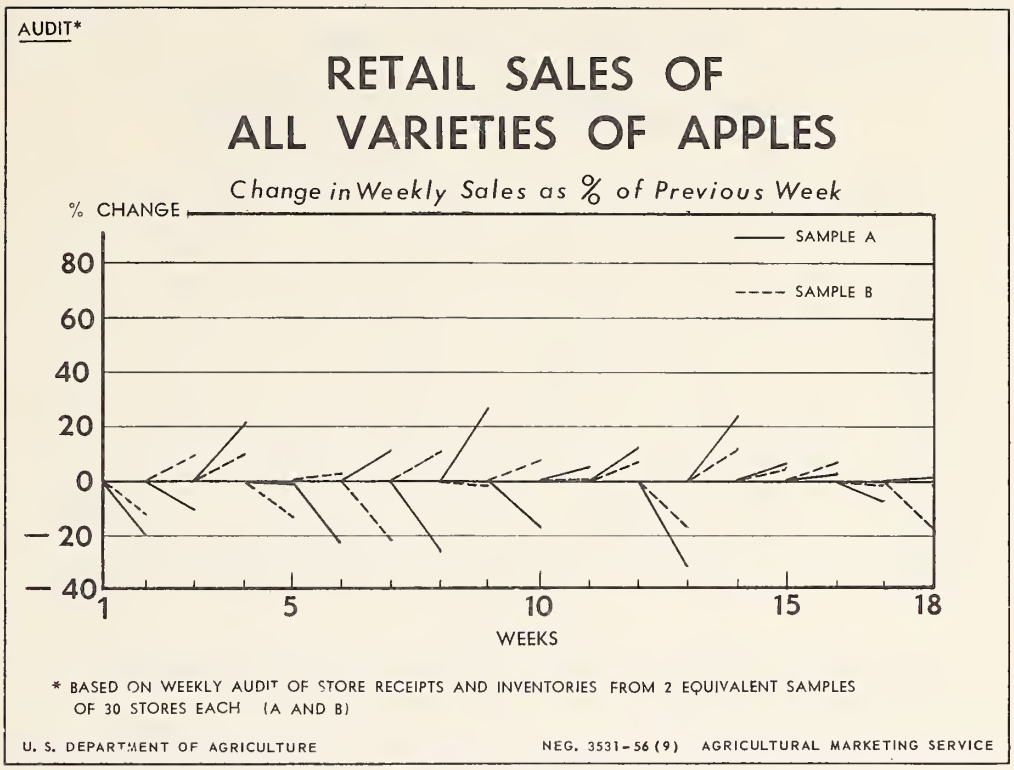

Figure 9.

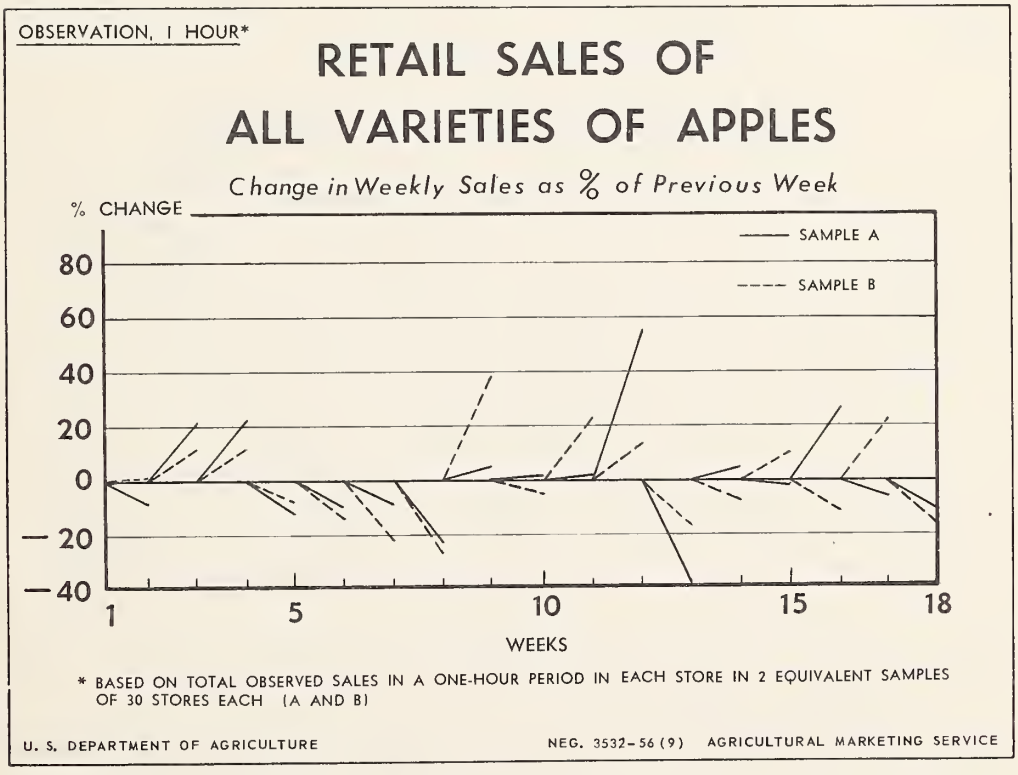

Figure 10.

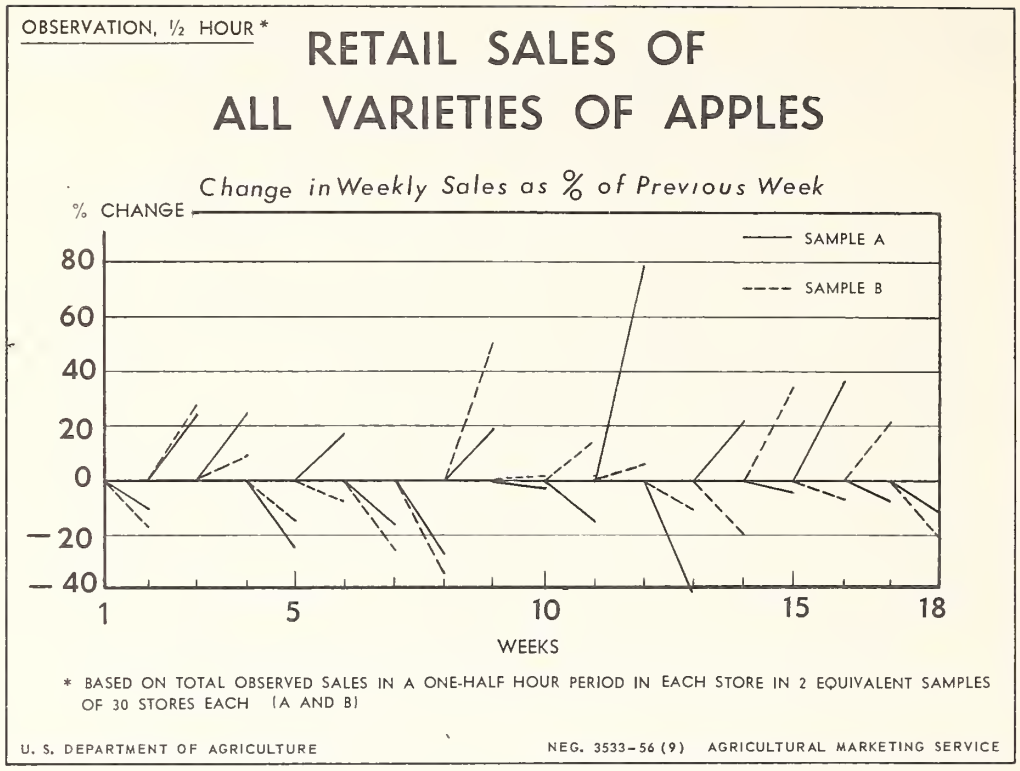

Figure 11.

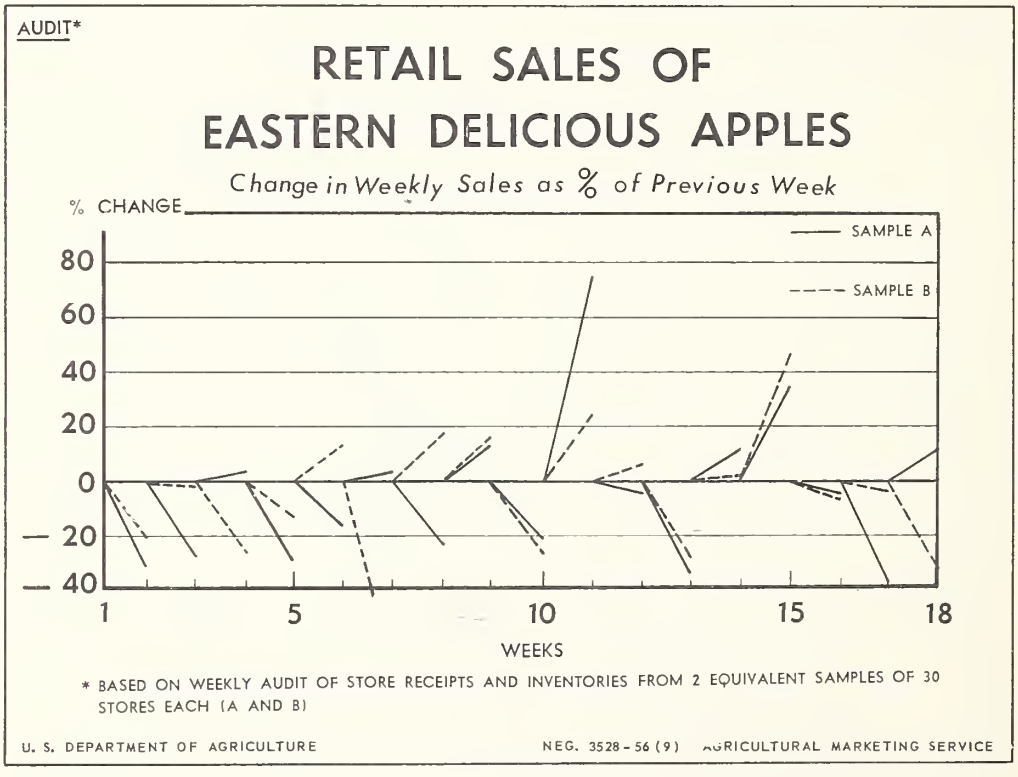

Figure 12.

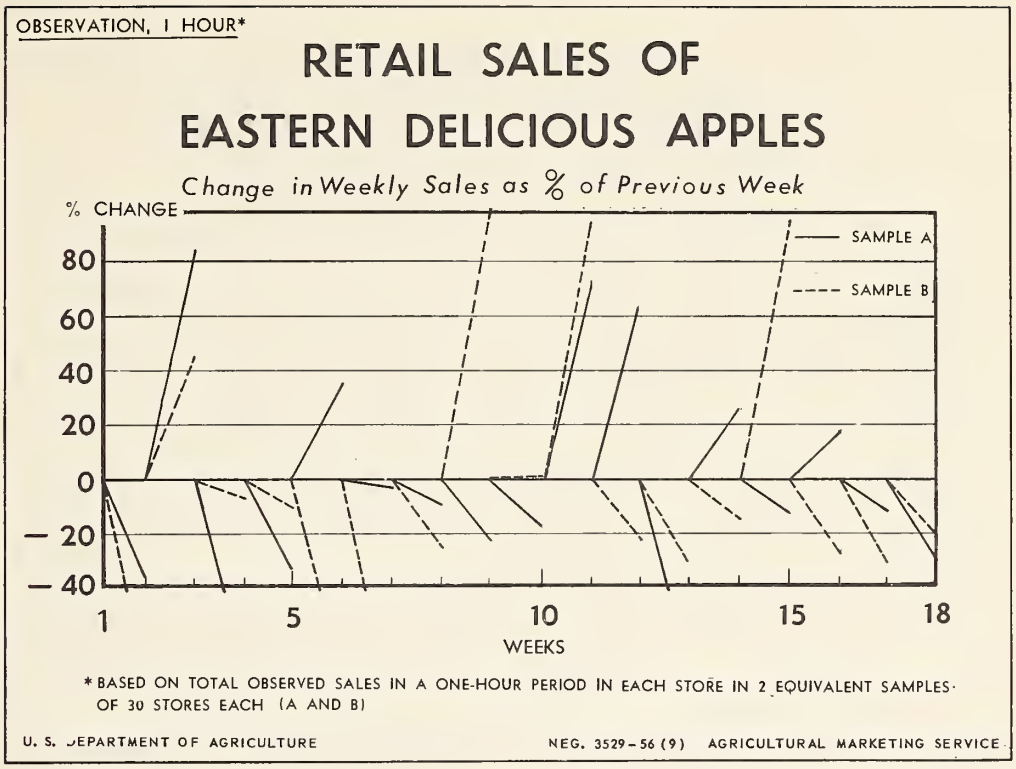

Figure 13.

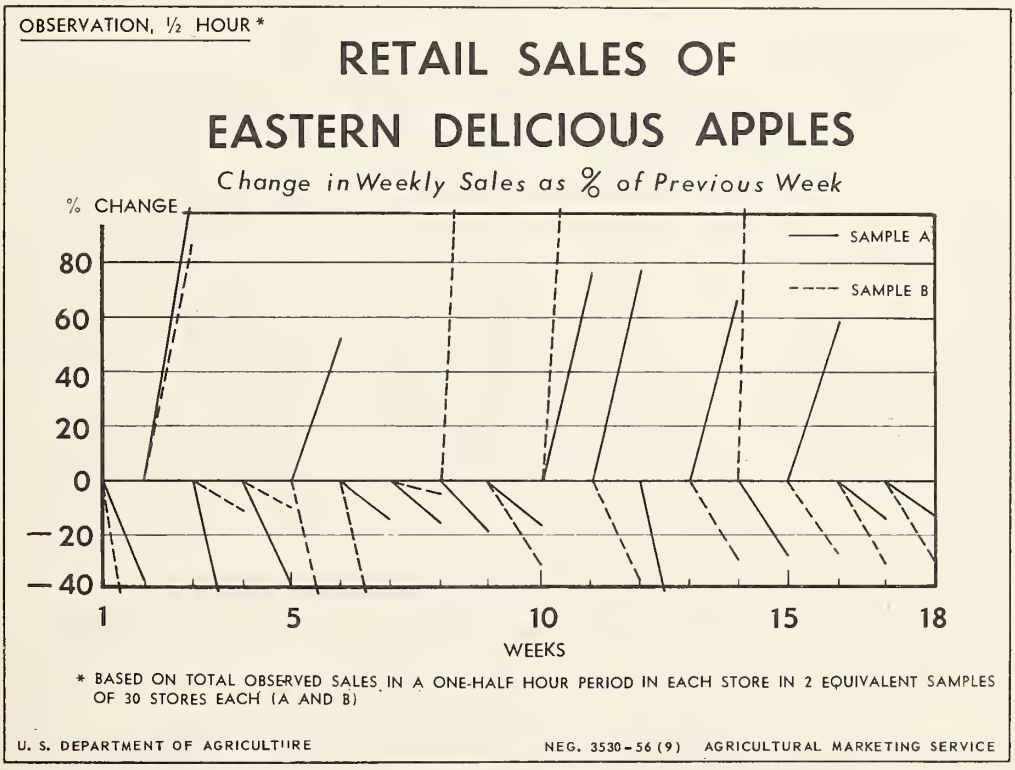

Figure 14.

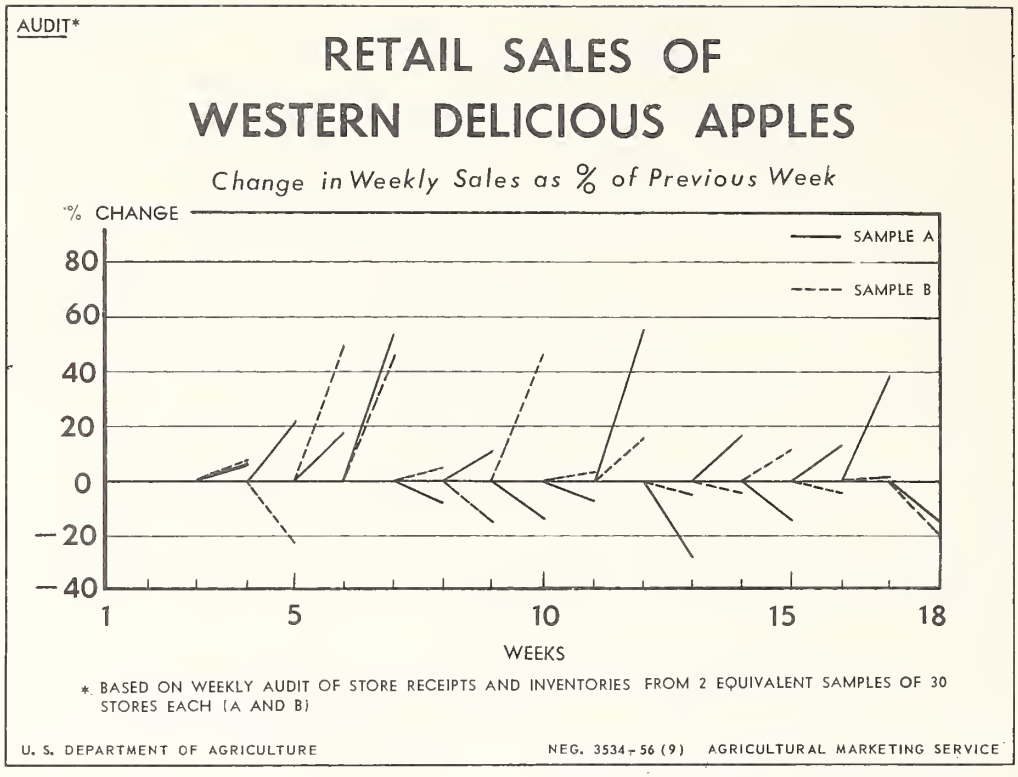

Figure 15.

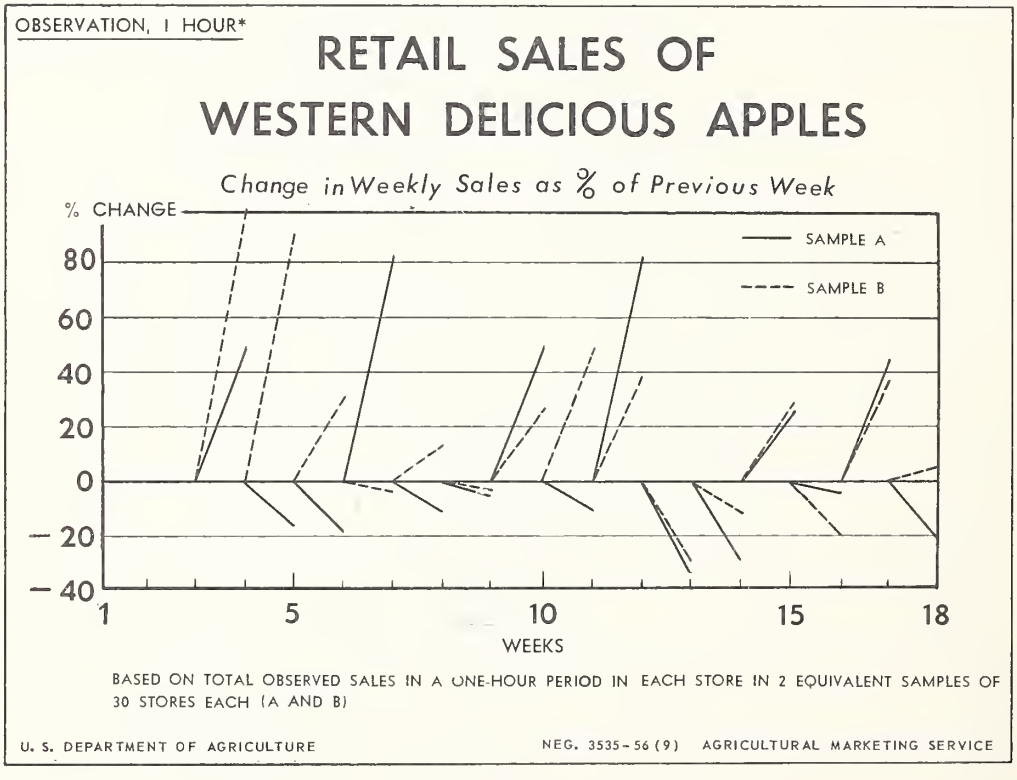

Figure 16.

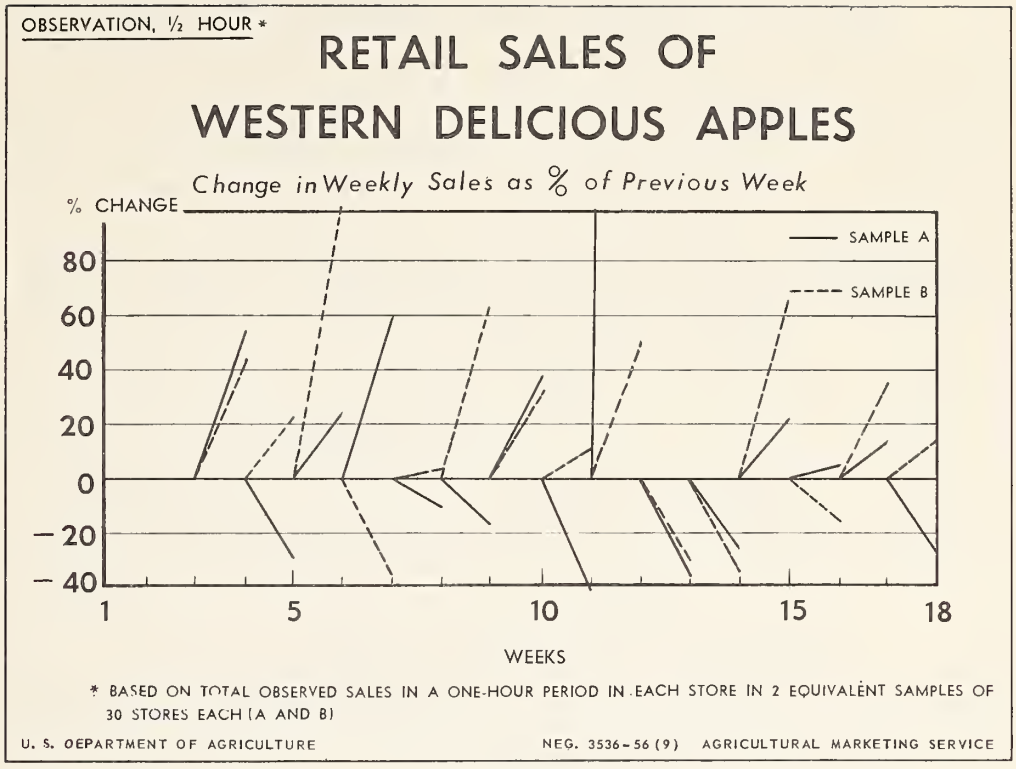

Figure 17.

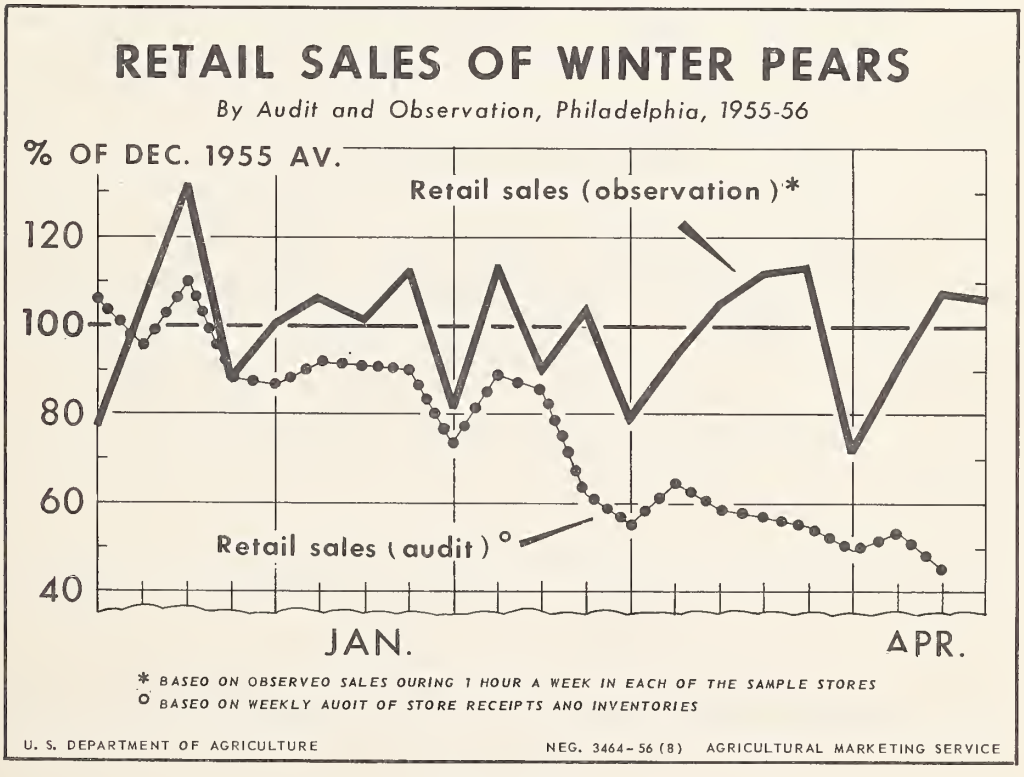
RETAIL SALES OF WINTER PEARS
By Audit and Observation, Philadelphia, 1955-56
% OF DEC. 1955 AV.
Retail sales (observation)*
120
100
80
60
40
Retail sales (audit) °
JAN.
APR.
* BASED ON OBSERVED SALES DURING 1 HOUR A WEEK IN EACH OF THE SAMPLE STORES
° BASED ON WEEKLY AUDIT OF STORE RECEIPTS AND INVENTORIES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 3464-56 (8) AGRICULTURAL MARKETING SERVICE

Figure 18.

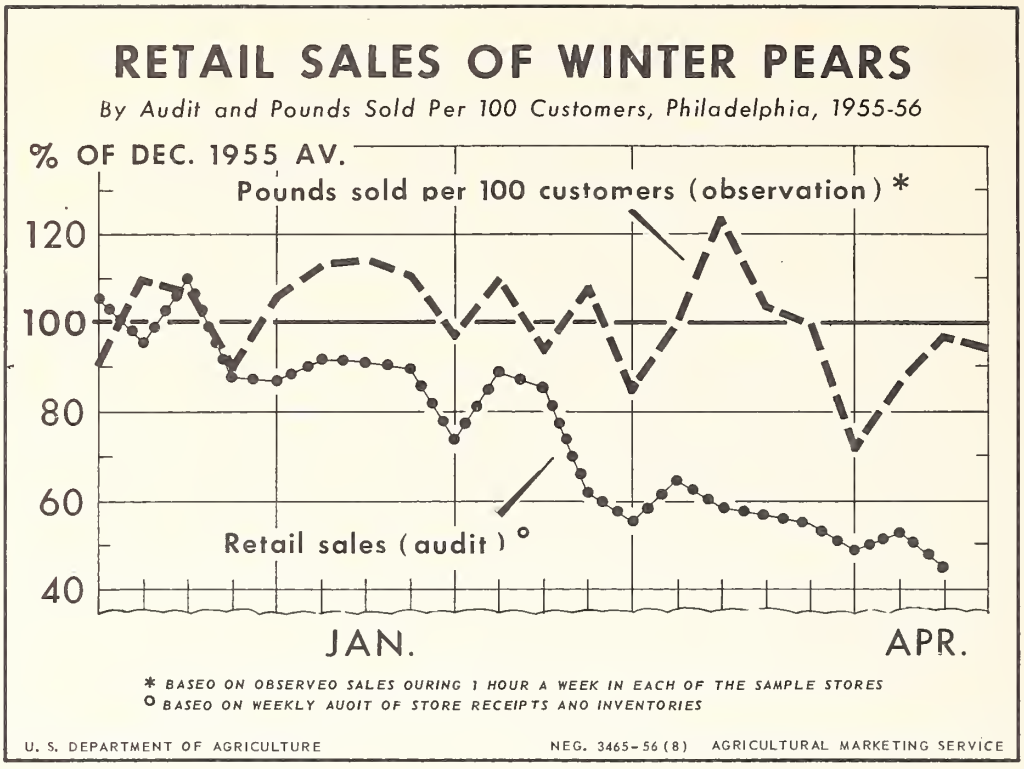
RETAIL SALES OF WINTER PEARS
By Audit and Pounds Sold Per 100 Customers, Philadelphia, 1955-56
% OF DEC. 1955 AV.
Pounds sold per 100 customers (observation) *
120
100
80
60
40
Retail sales (audit) °
JAN.
APR.
* BASED ON OBSERVED SALES DURING 1 HOUR A WEEK IN EACH OF THE SAMPLE STORES
° BASED ON WEEKLY AUDIT OF STORE RECEIPTS AND INVENTORIES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 3465-56 (8) AGRICULTURAL MARKETING SERVICE

Figure 19.

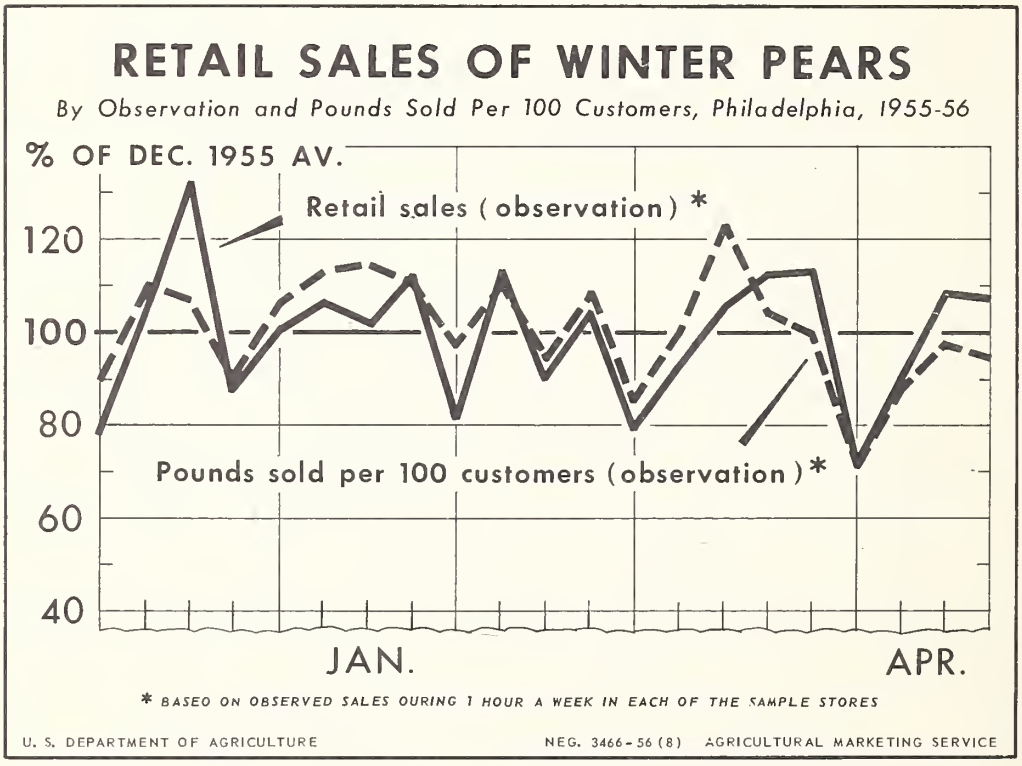
RETAIL SALES OF WINTER PEARS
By Observation and Pounds Sold Per 100 Customers, Philadelphia, 1955-56
% OF DEC. 1955 AV.
Retail sales (observation) *
120
100
80
Pounds sold per 100 customers (observation) *
60
40
JAN.
APR.
* BASED ON OBSERVED SALES DURING 1 HOUR A WEEK IN EACH OF THE SAMPLE STORES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 3466-56 (8) AGRICULTURAL MARKETING SERVICE

Figure 20.